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EMIS FINAL REPORT

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GEORGIA EDUCATION MANAGEMENT PROJECT (EMP)
SHORT-TERM TECHNICAL ASSISTANCE REPORT

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CONTENTS

ACRONYMS

EMIS	Education Management Information System
EMP	Education Management Project
ERC	Education Resource Center
GB	Gigabyte
GIS	Geographic Information System
IRM	Information Resources Management
MoES	Ministry of Education and Science
MOU	Memorandum of Understanding
RAM	Random Access Memory
SIS	Student Information System
SAN	Storage Area Network
SQL	Structured Query Language
TB	Terabyte
TOR	Terms of Reference

INTRODUCTION

This document is to be considered as the final document on the Georgia EMP EMIS development efforts begun in June 2009 in conjunction with the Ministry of Education and Science (MoES). The purpose of this document is threefold:

- To describe the EMIS project from inception to the present day,
- Review the functionalities of existing systems as they are today, and
- Propose areas for further development should future donor support become available.

The next section, project history, will be broken down by year with the individual tasks and development efforts undertaken within each year being detailed.

PROJECT HISTORY

2009. July – August: First Site Visit.

The original intent of the EMIS project was to provide recommendations on how to expand the existing EMIS system in place at the ministry. These efforts were to fall under the ***Georgian Education Management Work Plan: GEM Output 2.3 – EMIS Further Developed to Provide Data for Decision Makers***. The initial site visit assessment concluded that, in fact, there was no functioning EMIS system in place at the ministry. There were only a small number of stand-alone systems operating on stand-alone equipment that collected information that provided very limited reporting capabilities for the ministry. The existing systems only tracked 240 variables and because the data was stored in Microsoft Access databases and Excel spreadsheets there was very little exchange of information between the existing systems and the data being collected was of dubious validity. Given the status of where the MoES stood in terms of infrastructure, hardware and software systems, along with the technical capabilities of the MoES staff, a high-level document was created detailing how a complete EMIS system could be implemented in Georgia.

2009. October – December: EMIS System Design Effort Begun.

During the second site visit, the scope of work changed from ***enhancing*** **the EMIS to** ***designing and building*** **an EMIS**. A true EMIS system is a collection of varied software applications such as Human Resources, Finance, Student Information System (SIS), teacher related systems such as Teacher Tracking Portfolio and Communities of Practice systems, Content and Learning Management systems, Transportation and Food Service systems, etc.

The Ministry of Education and GEM agreed to select a key component of an EMIS system, a Student Information System, as the first system to be developed. To ensure the smooth functioning of the project, a group, the EMIS Working Group, composed of ministry, EMP, and outside consultants, was formed to coordinate the development of the EMIS modules.

A gap analysis was conducted and a scope of needed resources was developed and the creation of the needed data elements for selected SIS module was begun. One critical item identified was the need for a data center given the ministry had only 5 stand-alone servers that would not meet the needs of Georgia's @2,200 public and @250 private schools.

2010. January – May: Development of SIS System Begun.

The ministry agreed that the development of the SIS would need to be done by an outside developer due to lack of human resources available within the ministry. An RFP was developed and awarded in March to Delta Systems, a local development group. The process took longer than expected due to a change in minister and key staff.

The following process was agreed to for the development process of the SIS:

- Formalization of tables and data elements with a strong emphasis on data validity. The following sub-modules were agreed upon for the SIS development:

    - Registration / Enrollment.
    - Scheduling.
    - Attendance.
    - Grading.
    - Reporting.

A prototyping process was developed that would ensure the SIS system would provide the following:

- Students would not be penalized for something out of their control.
- Students do not lose valuable days of instruction
- System would prepare for the day that attendance would take greater importance to generate per student funding. This work was to be tied to the work being done by Dori Neilson.

In addition, sub-module specific processes were developed that would be incorporated in the development of the SIS system. Twenty schools were selected by MoES to test the SIS development effort and there was agreement the development effort would be concentrated on the following tasks:

- Formalization of tables and data elements:

    - Strong emphasis on data validation using drop down list boxes and creation of centralized validation tables.

- Self-correcting mechanisms placed in code to ensure compliance with statutes and established rules.

- Process prototyping:

  - Developed steps for attendance, registration, scheduling and grading.
  - Provided ministry with recommendations on possible ways to deal with issues related to registration, reenrollment, attendance, scheduling and grading.

By the end of May SIS coding commences and the planning for how the expansion of EMIS could be undertaken was begun.

2010. June – July: Data Center Feasibility Study.

From the very beginning of the project it was clear the infrastructure of the ministry would not be up to the tasking of hosting a fully functioning EMIS system and the original plans to perhaps host the EMIS at the Civil Registry fell through. It was agreed the MoES would develop their own data center with appropriate equipment and to that end equipment specifications were prepared. From these specifications an RFP was developed and awarded to UGT, a local vendor, in July. The data center to be built would provide the MoES with the following capabilities:

- Efficient performance for a large number of users that will grow over time.
- Scalability for future module integration.
- Security against intranet and internet hackers.
- Reliability through equipment redundancy and resiliency.
- Manageability for cost effectiveness and efficient management and technical support.
- Connectivity to other data resources such as the Civil Registry to allow for the exchange of information between governmental agencies.

2010. July: USA Study Tour.

Since the beginning of the project in 2009, discussions were held about the possibility of sending MoES personnel to the United States to visit with their American counterparts and see how the teaching and learning process was conducted and how information systems were used in the United States to further the education process along. In June, USAID agreed to fund this trip and a select group of MoES and EMP staff visited Fairfax County Public Schools in Fairfax Virginia, Tucson Unified School District in Tucson, Arizona and Lake Washington School District in Lake Washington, Washington in July.

The group met with board members, school district superintendents, directors, and curriculum and support staff at each of these school districts and were able to interact with the learning management and content systems in place that were used to deliver

instructional services, the administrative systems that managed the students (SIS), human resources and finance. Because of the strong emphasis that the MoES places on vocational education, the group also got to see and interact with the vocational programs in place at each of the school districts visited.

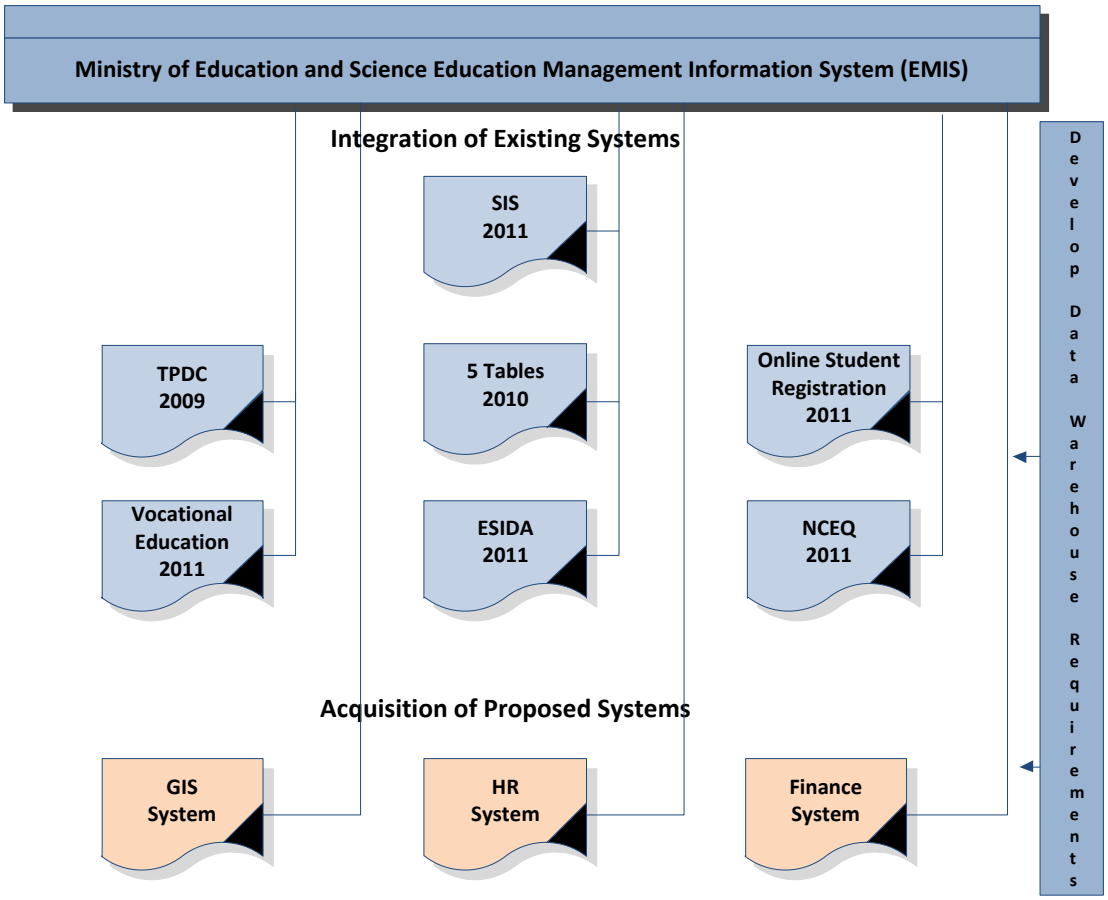
2010. October – 2011. July: SIS Development and Build Out of Data Center.

As anticipated the pilot phase of the SIS project saw the ministry working through problems encountered by the schools testing the system. The problems encountered fell into three general areas. The first, data validity issues, showed that the ministry's original student database was incomplete as a large percentage of students were not showing up in the schools testing the system. The second issue revolved on having an incomplete teacher database. The third issue dealt with issues related to application bugs. There was also some retooling to the SIS system due to new directives which were issued by the MoES.

The data center was brought online and the ministry was able to connect about 1,000 schools to the Wide Area Network. By July the SIS Phase I development process was complete and Delta Systems transferred the SIS from their data center to the MoES data center without any problems.

2011. August – December: Continued SIS Testing and Integration Begun.

Between August and December the ministry continued to test the SIS system and begin the process of integrating the SIS system into the other systems in place or in development. A graph of the existing and proposed systems follows:



It was clear that the existing systems do not align well not only with the SIS system but with each other. This was due primarily by the data elements not aligning well between the systems and because much of the same data was being collected by each system but in a format and process that led to a great many validity issues.

As the integration process continued it became clear that a data warehouse, where data could be stored from all the existing systems was needed to address the issues encountered as the MoES tried to integrate the existing systems. Having a data warehouse available would allow the ministry to:

- Have common data sets to allow for easier manipulation of data and creation of reports,
- Develop long term repository of information to allow the ministry to do "what if" reports and become more data driven.

A feasibility study of what it would take and cost to develop a data warehouse for the MoES was undertaken. EMP and the MoES agreed that the development of the data warehouse was very much needed and USAID agreed to fund this effort. This effort was to be combined with the development of a Graphical Information System (GIS) as it would align well with the creation of the School Report Card system the ministry was in the process of developing.

2011. November: Data Warehouse, GIS system, and School Report Cards.

With the go ahead from USAID to develop a data warehouse it was agreed that the system would be developed in-house with assistance from EMP staff and consultants. The data warehouse would consolidate data from all existing systems and the upcoming GIS system as well. This data would then be used to create the School Report Card system as well as other reports.

The need for the GIS was driven by the need for the ministry to look at large data sets in graphical form to make it easier to see patterns to allow it to make better decisions on where to allocate resources. The initial scope of the GIS system will concentrate on the following capabilities:

- School optimization and capacity planning.
- School profiles.
- See how student achievement is impacted by mobility, discipline, etc.
- Comparison of achievement information across schools and regions.
- "What if" planning.
- Bus Routes.

The RFP process saw a decision to acquire ARC GIS, as it is a common system used in Georgia and they would be able to provide maps, training and custom programing if needed. It met all the ministry's needs as well.

The data warehouse and GIS efforts would tie in nicely with the MoES decision to develop a system that would provide parents and other interested parties a school report card detailing how schools are doing in terms of achievement and resource allocation. The original attempt at creating the school report cards saw a great deal of validity errors and it is hoped that the development of the data warehouse, the GIS, and other future systems will correct this since all data for the report card will be validated before it enters the data warehouse. Since the warehouse would store information from prior years, the school report cards could also provide historical comparison data.

2011. November: SIS Video Tutorials.

A key problem that became apparent when the schools began testing the SIS was how to train staff in the proper use of the system. Given the large number of schools and their wide distribution across Georgia, it was agreed that video tutorials would be developed that would allow school personnel to review the video tutorial anytime and anywhere. The MoES agreed to use video tutorials for registration, attendance, grading, and administration processes. The videos would be developed around tasks and not specific job functions to allow school personnel to become acquainted with all facets of the SIS thus being able to move around different tasks and as a means of allowing staff to move into different job openings.

To ensure good quality streaming capabilities, the videos would be rendered in Flash and in a resolution that would fit most ministry devices such as laptops and personal computers. It was agreed the format would be 4:3 and 640x480 to ensure that it would run well on the ministry's equipment and not take up too much bandwidth.

CURRENT STATUS

2012. January – April 2012: Development of Data Warehouse, GIS and Videos.

Since January, the focus has been in completing work on the data warehouse, GIS and video tutorials to ensure the base systems are in place by the end date of this project in June. What follows is a short summation of what has actually been done with these tasks as each of the tasks has an accompanying document those details quite thoroughly the work done to date.

On the data warehouse front, work has been on-going through the use of weekly conference calls with MoES and EMP staff to develop a unified table structure that will see data coming into the warehouse from all existing and planned systems in an agreed upon format. Work has also been done on determining which of the existing systems will be the owner of the data so that the current problems of data duplication with the accompanying validity issues become a thing of the past. The document entitled ***Data Warehouse Fields*** provides the needed information for the ministry to develop the needed tables and data elements to be used by the warehouse and a brief summary detailing how the data can be used for reporting purposes.

Work also continues on developing the list of data elements that should be part of the GIS system. It is anticipated that while the GIS system will be the creator and owner of this data, the data will be shared with the data warehouse and will be used in the creation of reports such as the School Report Cards. The document entitled ***Development Concepts for Georgian MoES GIS System*** contains a detailed list of the data elements that have been identified for inclusion into the GIS system with an accompanying explanation on how the data can be used to make the ministry more data driven.

Within the GIS system itself the ministry has made progress in setting up the application. To date, the map of Georgia has been created and all schools have been entered into the system and their GPS coordinates and other high-level information such as the region, individual school legal information as well as schools that are participating in the computer generated examination program have been identified. The work plan for the near future includes the addition of the following data points:

- Student counts
- Number of certificated staff
- School building usability information
- Number of books in the library
- School personnel counts
- Data for School Report Cards
- Sport facility information
- Number of computers in school

- Internet access availability
- Languages taught in school
- Extracurricular activities
- Pupil / teacher ratio
- Number of teachers with Master's
- Number of students that have completed Olympiad
- Student / Computer ratio
- Number of students who have passed examination tests
- Number of gold and silver students
- Availability of a school nurse
- Number of courses taught
- Number of shifts
- Number of teachers with endorsements
- Number of certified teachers
- Number of students that have received presidential grants
- % of students who have graduated
- Number of students who have received scholarships
- Number of students from each family attending school

One key issue facing the MoES is how to ensure the validity of the information it will save to the data warehouse. This is driven by the fact that the existing systems collect some of the same information as other systems but this information is not collected in the same manner or stored within these stand-alone systems in the same way leading to the validity issues and to comparative analysis problems because the same data elements are collected with varying lengths and of differing data types.

The ministry was faced with three ways of dealing with this issue: 1.) it could ensure the validity of the information within each stand-alone system, 2.) it could do data validation within the data warehouse, or 3.) it could develop a middle-ware business intelligence module that would sit between the stand-alone systems and the data warehouse. During the development of the data warehouse and GIS data element tables, it became clear that the best approach would be to employ the middle-ware business intelligence module as a means of dealing with this issue. The rationale for this was that it was unlikely the ministry would be able to go back and retool the existing systems to include new validity mechanisms and given that the stand-alone systems would all be feeding the data warehouse with much of the data being replicated, it would be very difficult to determine within the data warehouse which system was providing the correct data. By employing the middle-ware solution, the ministry would be able to develop the appropriate business rules which would deal with determining which stand-alone system would be the primary owner of any given data element and using business intelligence rules would be able to ensure that only correct information would be sent to the data warehouse and this information could also be sent to any of the other systems which used the same data elements. So, for example, the SIS system would be the primary owner of a student's first and last name, and using business intelligence rules this information would be entered into the data warehouse in an appropriate format and this information would also be used to replace data which might be incorrect in any other stand-alone system such as the eStudents system which also collects student's first and last name.

The ministry has agreed to use the proposed middle-ware methodology and to use the data warehouse naming conventions and data element field information in the development of new systems and this methodology will also be applied to the GIS system that is currently being developed.

In regards to availability of financial information, very little work has been done to consolidate the financial data that exists across the Five Tables system which, with the effort to consolidate the financial information, have had an official name change to Finance Reporting System. This lack of progress is being driven primarily due to ministry staff being dedicated to working on other systems which are deemed to be more important at the moment. The original recommendation of having the ministry take the annual budget, annual revenue, and annual expenditures from across the Five Tables and place that information into the data warehouse to be used to produce reports such as the School Report Cards still stands and the ministry is working hard to make this happen. With the agreement of how data should be validated and entered into the data warehouse, the ministry should be able to quickly move to have access to this rudimentary financial data once staff resources open up. It should be noted the Finance Reporting System is based on the aggregation of financial data which could pose an issue in terms of future data mining efforts. This would be remediated with the recommendation in the future EMIS development section that a true ERP system be implemented.

The SIS Video Tutorials are also nearing completion. To date 34 of the approximately 38 needed videos have been completed. The holdup on the final 4 videos has been due to a technical issue relating to the need for the date on the servers needing to be changed so that a process can be run and allow the video tutorial developers to capture this process on video. The ministry agreed to make the change the weekend of April 28th, when no one is using the system, so that these last videos can be produced. One positive outcome has been the inclusion of higher resolution videos being created by the developers. The original scope of work called for videos having a resolution of 640 x 480 to ensure that every device in use by the ministry could display the videos correctly. However, given that much of the equipment in use by the ministry is fairly new and can, therefore, run at higher resolutions, the developers went ahead and recompiled the video tutorials to also run at 800 x 600 resolution. This will make the videos much easier to see on those devices that can run at higher resolutions.

At this point the videos can be run from a web page that provides access to each video either in 640 x 480 or 800 x 600 resolutions. The web page also provides a description of what is the purpose of each video, i.e. grading, registration, attendance, administration, etc. The ministry has agreed that it would also make sense to place code on each of the SIS modules to allow the relevant video tutorials to run from within each of the modules. So, for example, if a user is on the grading module and is confused about how to accomplish a task within this module, they will be able to click on a link on the page that will display the appropriate video for that task. This will make it easier on the end-user as they will not have to leave the SIS system to run a tutorial and the SIS system will provide access to only those videos that relate to the specific task the end-user is trying to accomplish. Finally, most of the videos have been developed to run no more than a minute long to ensure that the end-user is not overwhelmed with information.

The ministry is in the process of installing servers at the schools and has agreed that the video tutorials will be placed on these servers so that they are available locally. This will make it easier for the staff at these schools to access the videos on demand

and will also mitigate any playability issues which might have arisen from bandwidth problems especially out in the rural areas of the country.

This project concludes at a point where the ministry where the EMIS can be expanded as originally contemplated at the start of the project. There is now in place a data center that can actually host an EMIS system, the ministry has made grade strides in developing some key systems such as the SIS, eStudents, and Financial Reporting System, and is now poised to take advantage of the lessons learned as it embarks in the development of the GIS system. What follows are some recommendations on how the ministry might wish to continue the development of the EMIS.

FUTURE EMIS DEVELOPMENT RECOMMENDATIONS.

Given the state of where this project started in 2009, the ministry should be quite proud about how much has been accomplished in three short years. 2012 sees the ministry with a rudimentary SIS system in place, a GIS system has been acquired, but only the data element creation process has been started on this project, there are other rudimentary systems that are recently developed or in the process of development and all of these systems will need to be integrated into the data warehouse. To ensure that the EMIS system continues to expand and remains sustainable, the following recommendations are intended to provide guidance on how the MoES might want to move forward with the development of the EMIS now that this phase of the project is coming to a close.

Continue Developing Data Warehouse Structures.

The majority of the work on the data warehouse has been to develop a crosswalk between the data elements contained in the current MoES information systems with the ones that will reside in the data warehouse. A great deal of effort was expended to ensure the validity of the data and to understand the flow of information within the ministry. The overall objective of the data warehouse project was to begin the collection of information that will allow the ministry to address the areas and goals outlined by the World Bank Report of 2005. Many of the data elements contained in the current data warehouse design can begin to provide answers to many of the areas indicated by the World Bank report, but some of the systems that would provide other needed information such as HR and finance information do not currently exist. As these systems are brought on line some thought should be given to how they are going to align to answer questions related to achievement, infrastructure and the use of resources as outlined in the World Bank report. Those indicators are as follows:

Areas/Goals	Indicators	Explanatory Notes
Educational Participation (Equity measures are embedded)	**1. Net Enrollment Rate** By learner gender By school type (public or private) By grade By level of education [Pre-schooling, Primary (1-5), Basic (5-8), Secondary (9-12), Vocational, and	Net enrollment rate measures the level of educational participation by children belonging to the official age-group corresponding to the given level of education

Areas/Goals	Indicators	Explanatory Notes
	Tertiary level] By race/ethnicity By Locality	
	2. Promotion Rate By school type By gender By grade By level of education By race/ethnicity By Locality	Promotion rate shows how many learners (as a %) advance from one grade to next grade
	3. Repetition Rate By school type By gender By grade By level of education By race/ethnicity By Locality	Repetition rate measures a general level of education system internal efficiency
	4. Dropout Rate By school type By gender By grade By level of education By race/ethnicity By Locality	Dropout rate helps assess a general condition of sustainable educational participation and internal efficiency
	5. Transition Rate By gender By age By school type By level of education By race/ethnicity By Locality	Transition rate provides information on the degree of access (or participation) from one level of education to a higher education system level. The percentage of graduates from previous level of education enters next level of education. Percentage of students who enters the first grade of a given education level and finishes that level within expected achievement and expected length of years. This is a measure of education system internal efficiency.
	6. Completion Rate By Gender By age By school type By level of education By race/ethnicity By Locality	
Educational Expenditure (Equity and quality measures are embedded)	**7. Percentage of Educational Expenditure of GNP**	This indicator reports a crude level of national funding for education (national level data)
	8. National Education Expenditure Per Pupil By school type By level of education By Locality	Complementary to the above but more accurate assessment of level of education expenditure (district level data)
	9. Percentage Distribution of Education Expenditure by Levels	Educational expenditure shared by pre-schooling, primary, basic, secondary, vocational, and tertiary levels (national data)
	10. Percentage of Family Contribution to Annual Education Cost By student gender By level of education By school type By race/ethnicity By locality	This indicator estimates family financial support/burden to child education relative to government financial support.
Teacher Characteristics	**11. Average Years of Teachers' Pre-Service Education**	The average years of education a teacher receives should inform the general level of

Areas/Goals	Indicators	Explanatory Notes
(Equality and quality measures are embedded)	By school type By gender By level of education By race/ethnicity By Locality **12. Average Hours of Teaching per Teacher per Week** By gender By age By subject of teaching By levels of education **13. Average Teacher Salary** By gender By age By levels of education	teachers' training and qualification. This may be useful for addressing issues about hiring criteria for teachers (school level data) Average hours of instructional teaching per teacher per week are a measure of teacher-students interaction time. It does not necessarily measure workload because it does not include course preparation time or other administrative work (school level data) (School level data)
School Characteristics (Equity and quality measures are embedded)	**14. Average Learner-Teacher Ratio** By school type By levels of education By subject of teaching (secondary or above) By locality **15. Average Class size** By subject of teaching By grade By levels of education **16. Learner-non-Teacher Ratio** By school type By levels of education By subject of teaching (secondary or above) By locality **17. Learner-Computer Ratio** By levels of education **18. Teacher-Computer Ratio** By levels of education **19. School Capacity Utilization Rate**	Learner-teacher ratio reports a general level of potential quality of learner and teacher interaction (school level data) Class size measures a general condition of school capacity and learner subject grouping (school level data) Learner-non-teaching ratio measures a general level of efficiency of school administration and support (school level data) Learner-computer ratio measures a general condition of pc technology in use in school. It can be useful for guiding new learning and teaching tools supported by technology as well as data management (school level data) Teacher-computer ratio reports on the general level of teacher access to computers. It can be useful for guiding training in instructional IT (school level data) Total enrollment divided by designed school capacity (school level data)
Educational Outputs	**18. Graduation Rate** By gender By age By level By race/ethnicity **19. Degree completion rate** By discipline & subject By race and ethnicity **20. National Standardized Achievement Test Results**	National test reports on the general levels of new curriculum-related achievement. Tracking

Areas/Goals	Indicators	Explanatory Notes
	By school type (public or private) By core subjects including Georgian, Math, Science, English, etc.) By levels of education (primary grade, basic grade, and secondary grade) By racial/ethnic group By Locality	scores over time creates valuable information on the output/outcome-oriented education development
	21. International Standard Achievement Test Results By gender By selected subjects By level of education By grade	Participation in international standardized tests will give us information on how Georgian learners compare to learners in other nations
	22. Examination Pass Rate By gender By grade By subject By level of education By locality	Pass rates from various levels of education should indicate the general group performance.
Students Attitudes	**23. Composite Index of Students' Attitudes toward Learning** By level of education By race/ethnicity By school type	
	24. Composite Index of Students' Attitudes toward Teaching By level of education By race/ethnicity By school type	
	25. Composite Index of Students' attitudes toward education system in general By level of education By race/ethnicity By school type	
Education Process	**26. Average Number of Hours of Instruction Learner Receives Per Week** By core subjects By levels of education (primary, basic, secondary, and tertiary) By school type (public or private)	Average number of subject hours received by student per week in various subjects will provide useful information on the allocation of various subject teaching and learning based on the curriculum standard (School level data)
	27. Average Number of Hours of Homework Assigned to Learners Per Week By core subjects By levels of education (primary, basic, secondary, tertiary) By school type (public or private)	Average number of hours of homework assigned to learners per week will provide useful information on how much general academic pressure students may receive
Educational Outcome	**28. Employment Rate** By level (high school, vocational and university) By race/ethnicity By school type	Percentage of graduates who are employed within 6 months of their graduation.
	29. Annual earnings By level By race/ethnicity By school type	Reported income by newly graduated employees

Continue Developing GIS Tables and Integrate Them Into Data Warehouse.
At this point in the development process the work being done with the GIS system is to collect the needed information to develop the School Report Cards. The system should be expanded to allow the MoES to begin to do school optimization and capacity planning and determine which factors, such as mobility and dropout rates, are impacting student achievement. With the acquisition and integration into the GIS system of the data maps, the ministry could begin to develop a bus routing system. As the ERP system comes online, the GIS could be used to provide the MoES guidance of where to allocate human resources and how to distribute capital resources.

The ministry should also consider using the GIS with the Georgia Primary Education Project. This project will create very complex data sets that will benefit from being able to look at these data sets graphically. This will require that the information being gathered by this project be added to the data warehouse and that the appropriate interface be developed that will allow the GIS to display this information in a predetermined graphical format. Having the information in the data warehouse will also allow the ministry to look at data over time as well as the data from each year of the project can be stored away and used for comparison purposes year upon year.

Continue Developing Reporting Module.

Since almost all development on the EMIS has focused on creating the necessary systems and data sources that the MoES will need, very little work has been done on the development of a reporting module. It is recommended the ministry take the time to expand the current rudimentary reporting capabilities of its systems and develop a comprehensive reporting module. As a first project the MoES should develop the School Report Card reporting system. The data elements that were created in the data warehouse were specifically designed to allow the ministry to complete the School Report Cards and to do comparative reports in subsequent years. Over time, the reporting system should be more fully aligned with the indicators provided by the World Bank report.

Develop Administrative Regulations.

As the ministry becomes more reliant on information systems to provide needed data, the need to have rules in place to provide guidance to staff on how systems and information will be used within the organization is critical. It is recommended that ministry develop the following:

- Acceptable use policies of MoES information systems and the data contained within these systems.
- Grades and attendance collection policies.
- Legal consent process for parents to be able to access student data.

- Accepted list of required documentation needed for enrollment of a student into a ministry school.

These policies should be readily available to all staff via mechanisms such as a web portal and some of the policies could be contained within the logon screen to ensure that all ministry staff are aware of the MoES rules related to system and data access. As parents are granted access to the system, they too will need to be made aware of any acceptable use and access policies that the ministry operates under.

Implement an ERP System.

The MoES has decided to develop a hybrid ERP system internally. This decision should be reconsidered. ERP systems are some of the most complex in any organization. The ministry does not have the expertise or the necessary programming resources to design, develop and maintain the type of ERP system that an organization of its size will require. A better approach would be to develop the specifications that would be needed for a system that would meet the MoES needs and to put a RFP out to acquire such a system. Over time the cost to maintain a commercially available ERP system would be much less and the MoES would know that as changes to the human resource practices and / or financial accounting rules occurred, that updates provided by the successful bidder would work correctly and not cause havoc as is often the case with home grown ERP systems due to the complexity of these systems. This would free the MoES to dedicate the likely limited programming resources to the student related information systems such as content management and learning management systems. One development strategy to consider, given the complexity of ERP systems, is for the ministry to implement a very limited subset of capabilities in both the HR and Financial modules so that it can start out small and continue to grow as the need for additional functionality develops within the organization. The key, then, is to find an ERP application that can grow with the ministry over time and not acquire an application that will force the MoES to acquire another system in a few years' time as this will be very destructive to the organization.

Hire More Staff and Provide More Training.

The ministry will need staff, which it currently does not have, that can keep the backend operations of the EMIS running smoothly. This is becoming a critical issue as the ministry adds more systems to the EMIS. The ministry has indicated that it would like to develop the needed talent in-house so some consideration should be given to ensuring that staff acquires the needed certifications to be able to effectively manage the infrastructure and back-end systems as well as be able to support the applications it is making available to end-users at the schools and departments. It should be noted that it takes some time to acquire these skills sets and that certification can be quite expensive so some thought should be given to contract out for some of the more technical needs until such time as the ministry is ready to take on that responsibility.

Hardware and Software Support

Given that the ministry is Microsoft centric, this will require staff with the following certifications or qualifications:

- **Microsoft Certified Systems Engineer (MCSE)**. These individuals provide support for issues related to hardware and operating systems and have expertise in network security, computer networking infrastructure, Active Directory, Exchange and SQL Server. MCSE's are also able to analyze the business requirements for information system solutions, and design and implement the infrastructure required.

- **Microsoft Certified Database Administrator (MCDBA)**. These individuals implement and administer Microsoft SQL Server databases. They develop database designs, develop logical data models, create physical databases, manage and maintain databases, configure and manage security, monitor and optimize databases, and install and configure SQL Server.

- **Microsoft Certified Systems Administrator (MCSA)**. These individuals are more like technicians and are not as skilled as MCSE's in that they only implement, manage and maintain the computing environment and do not plan, design and implement the computing environment as a MCSE would.

Application Support and Training

These individuals will develop the EMIS and support the applications that derive from the software development efforts. These staff will require the following certifications or qualifications:

- **Microsoft Certified Application Developer (MCAD)**. These individuals have mid-level programming skill sets in key Microsoft technologies such as .NET and Visual Studio and these are the individuals tasked with developing the SIS.

- **Microsoft Certified Solution Developer (MCSD)**. These individuals have the highest level programming skill sets in key Microsoft technologies such as .Net and Visual Studio and these are the individuals that would be tasked with leading the MCAD's in the development of the SIS.

- **Microsoft Certified Desktop Support Technician (MCDST).** These individuals support end users and troubleshoot desktop environments running Microsoft Windows operating systems. These individuals should be housed at both the central office and ERC's to provide support to the schools.

- **The Microsoft Office Specialist (MOS)**. These individuals support the Microsoft Office suite of business applications. These individuals should be housed at the central office, the ERC's, and ideally, if the monies exist to get certification, at the schools.

- **Microsoft Certified Trainer (MCT)**. These individuals conduct training in any of the commercially acquired applications, such as Microsoft Office, as

well as any in-house developed applications such as the EMIS. These individuals should be housed at the central office.

What is recommended in this section is way beyond where the ministry is today. However, these skill sets will be a necessity as EMIS systems are very complex systems that require a great deal of knowledge of systems, hardware and software, and application programming development methodologies.